JHelioviewer

A JPEG 2000-based Discovery Infrastructure for Solar Image Data

D.A.N. Müller[1], B. Wamsler[2], G. Dimitoglou[3], J. Ireland[4], V.K. Hughitt[4], A. Alexanderian[5], B. Fleck[1]

[1]European Space Agency, NASA GSFC, USA, [2]Fakultät für Mechatronik und Medizintechnik, Hochschule Ulm, Germany, [3]Department of Computer Science, Hood College, USA, [4]ADNET Systems Inc., NASA GSFC, USA, [5]Department of Mathematics and Statistics, University of Maryland, USA

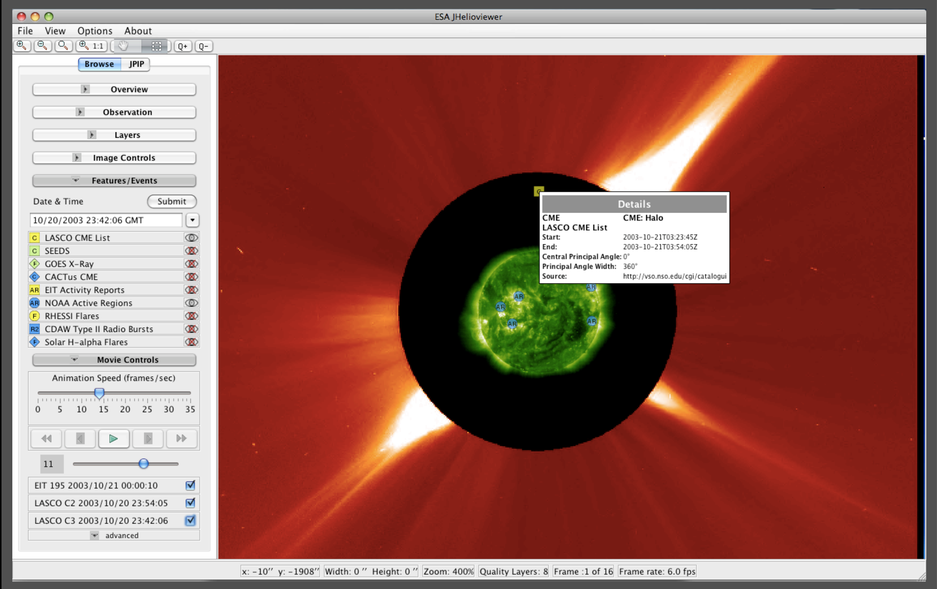
Abstract

JHelioviewer is a novel solar data browser geared towards large and complex data sets from SOHO, STEREO and SDO. It is based on the JPEG 2000 compression standard for highly efficient browsing in space and time. For example, movies with arbitrary cadence are generated in real time and can be manipulated while playing. Our approach is both flexible, scalable and platform-independent. The random code stream access of the interactive JPIP protocol minimizes data transfer and encapsulates meta data as well a multiple spectral channels in one data stream. This approach offers a solution to the problem of distributing the vast amount of SDO data to the world-wide community.

What is JPEG 2000?

JPEG 2000 is a wavelet-based image compression standard. It was created by the Joint Photographic Experts Group[1] with the intention of superseding their original discrete cosine transform-based JPEG standard (created about 1991) and offers multiple advantages over other compression schemes.

JHelioviewer in Action



- **Observation**: Select instrument, date range and cadence
- **Layers**: Show/hide/add image layers
- **Image Controls**: Apply color tables, ɣ-correction, sharpening, change opacities
- **Features/Events**: Display solar event data
- **Movie Controls**: Play movies and overlays of movies at variable speed - they can even have non-uniform cadence

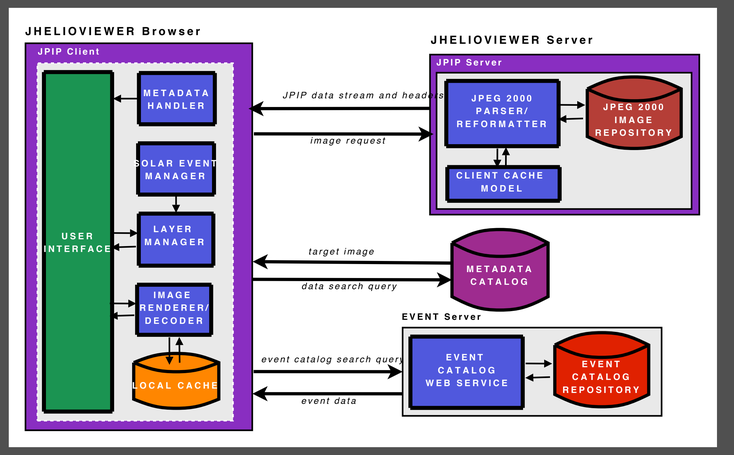
Functionality

- Overlaying and nesting images and movies
- Efficient image manipulation on-the-fly, even while playing movies
- Displaying meta data, e.g. solar events from various databases

Implementation

- JHelioviewer is an open-source application[2], implemented in Java
- Uses the efficient Kakadu Software[3] C++ implementation of the JPEG 2000 standard under non-commercial license
- Can be launched as a stand-alone application or from any web browser using Java Web Start databases
- platform independent: runs on Linux, Mac OS X and Windows

Architecture



The JHelioviewer architecture with its basic parts and components: the browser (client), server and the solar event server.

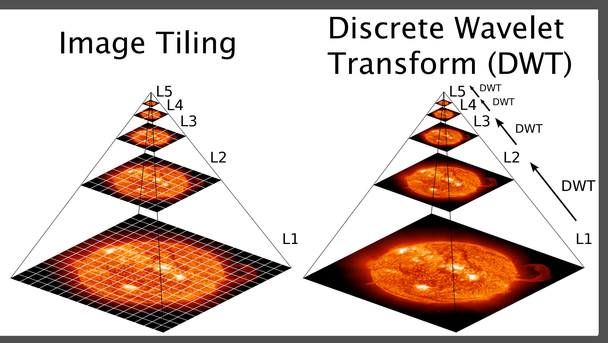
Advantages of JPEG 2000

- Multiple resolution representation: Images at different resolutions are automatically created during the wavelet compression process
- Random code stream access via the JPIP protocol: Huge images and movies can be accessed while downloading only selected parts of the data
- Quality layers: Remote images can be streamed and displayed at variable quality to optimize bandwidth usage
- Flexible file format enables remote access and inclusion of rich metadata
- Superior compression performance
- Read/write routines built into IDL

Multi-Level Wavelet Transform vs. Image Tiling

- Multiple resolution representation: A single JPEG 2000 file replaces a tile pyramid of hundreds of files (à la Google Maps), thereby reducing both the data volume and the size of the data base

resolution level	number of files
L5	1
L4	4
L3	16
L2	64
L1	256
total:	341 files



References

[1]http://www.jpeg.org/jpeg2000/
[2]https://launchpad.net/helioviewer
[3]http://www.kakadusoftware.com

Contact: Daniel Müller

dmueller@esa.nascom.nasa.gov